IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

POLAROID CORPORATION	)	
	)	
Plaintiff,	)	
	)	
v.	)	C.A. No. 06-738 (SLR)
	)	
HEWLETT-PACKARD COMPANY,	)	**REDACTED VERSION**
	)	
Defendant.	)	

POLAROID CORPORATION'S OPENING BRIEF IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT THAT CLAIMS 1-3 OF U.S. PATENT NO. 4,829,381 ARE NOT OBVIOUS

MORRIS, NICHOLS, ARSHT & TUNNELL LLP
Jack B. Blumenfeld (#1014)
Julia Heaney (#3052)
1201 N. Market Street
Wilmington, Delaware 19801
(302) 658-9200
jheaney@mnat.com
jblumenfeld@mnat.com

Attorneys for Plaintiff Polaroid Corporation

OF COUNSEL:

Russell E. Levine, P.C.
G. Courtney Holohan
Michelle W. Skinner
David W. Higer
Maria A. Meginnes
KIRKLAND & ELLIS LLP
200 East Randolph Drive
Chicago, IL 60601
(312) 861-2000

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NATURE AND STAGE OF THE PROCEEDING

Plaintiff Polaroid Corporation ("Polaroid") brought suit against Defendant Hewlett-Packard Company ("HP") for infringing Claims 1–3 and 7–9 of Polaroid's U. S. Patent No. 4,829,381 ("the '381 patent"). The invention in the '381 patent enhances the appearance of digital pictures taken with a camera and then subsequently viewed on the camera, a computer, or in a hardcopy print from a printer by altering the contrast at the specific areas of the image that are either too dark or too bright. This enhancement draws out detail that otherwise would be lost in digital images. HP asserts that the '381 patent is invalid. Fact discovery closed on February 8, 2008 and expert discovery closed on May 9, 2008. Polaroid hereby moves for summary judgment that Claims 1–3 of the '381 patent are not obvious.

SUMMARY OF THE ARGUMENT

1. Polaroid's motion for summary judgment of non-obviousness should be granted because Claims 1–3 of the '381 patent would not have been obvious to one of ordinary skill in the art at the time of the invention in view of HP's alleged prior art because no combination of any of the proffered references, or any reference alone, would result in the invention claimed in Claims 1–3.

2. Claims 1–3 of the '381 patent claim a system for transforming digital images on a pixel-by-pixel basis by using a specific algorithm. HP's cited art would not have suggested to a person having ordinary skill in the art that it was even possible to dynamically enhance electronic information signals using the claimed functions. Therefore, a person of ordinary skill in the art would not have an apparent reason to combine HP's references nor would he or she have a reasonable expectation of success in doing so.

3. In addition, there is objective evidence that Claims 1–3 of the '381 patent are not obvious. On the undisputed facts, Claims 1–3 are not obvious in view of the HP's art.

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STATEMENT OF FACTS

A. Background Of The Technology.

Prior to the invention claimed in the '381 patent, it was difficult to print or display digital images so that they accurately reflected the real-world scene captured in the image. J.A. Ex. A, '381 Pat., col. 1, lines 26–35.[1] This is because output devices are unable to print or display the wide range of scene variations that actually exist. *Id.* To compensate, output devices compress brightness variations and detail in areas of an image that are either too dark due to shadows, or too bright due to excessive sunlight. *Id.* As a result, details in those areas of an image are lost during the output process, resulting in poor output quality. *Id.*, lines 30–35. Prior art systems, such as those that transformed each pixel of an image equally, did not resolve this problem. *Id.*, lines 41–45. The invention disclosed by the '381 patent, however, eliminates or minimizes this problem.

B. Polaroid's '381 Patent.

Drs. Woo-Jin Song and Donald S. Levinstone are the inventors of the '381 patent. J.A. Ex. A, '381 Pat., cover page. The '381 patent discloses and claims their invention for a system and method that improves contrast in areas of a digital image that are either too dark or too light. *Id.*, col. 1, lines 48–50. Their approach alters contrast based on brightness conditions in specific areas of a digital image rather than applying a global correction to the entire image. *Id.*, col. 2, lines 57–63. In this way, the invention of the '381 patent makes the dark areas of an image brighter while simultaneously making the bright areas darker. *Id.*, Abstract, col. 2, lines 57–62.

Figure 1 of the Patent shows the patented system for transforming images:

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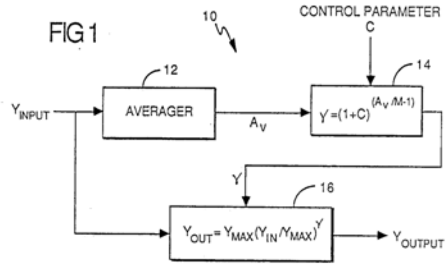
[1] Documents common to more than one summary judgment motion are contained in a Joint Appendix and will be cited as "J.A. Ex. __." Documents related only to the instant motion are contained in a separate Appendix and will be cited as "Ex. __."

[redacted]

FIG 1



In Figure 1, Y_{INPUT} represents the electronic information signals associated with the pixels that define the digital image being transformed, which enter the patented system one after the other. *Id.*, col. 3, lines 1–6. The first step in the transformation process is to define a window, local neighborhood, or plurality of pixels that includes the pixel to be transformed. *Id.*, col. 3, lines 59–61. The intensity values associated with the group of pixels are then averaged by the averager **12** as shown in Figure 1 above. J.A. Ex. A, '381 Pat., col. 3, lines 59–61. The '381 patent teaches that the averaging step is performed by a low pass filter or block average. *Id.*, col. 3, line 61–col. 4, line 25. With either of these methods, the pixel values contained within the window are used to calculate one average for that window and the value becomes associated with the pixel to be transformed. *Id.*, col. 3, line 59–col. 4, line 16.

The next step in the process is to use the average value associated with the pixel to be transformed from the previous step to calculate gamma (γ) in accordance with the equation: $\gamma=(1+C)^{(Av/M-1)}$. *See id.*, col. 4, lines 26–55. In this equation, C is a constant that is chosen based on the desired amount of correction. *Id.*, col. 4, lines 51–55. A_v is the average value calculated by the averager **12**. *Id.*, col.4, lines 26–30. M is a number within the dynamic range of the image to be transformed, which is 0–255 for an 8-bit image. *See id.*, col. 4, lines 41–50.

The final step is to use γ to select the transfer function imposed in the transfer function imposing circuit **16** to determine the output pixel value (Y_{OUT}) as follows: $Y_{OUT} = Y_{MAX}(Y_{IN}/Y_{MAX})^{\gamma}$. *See id.*, col. 4, lines 56–65. In this equation, Y_{MAX} is the maximum value of

[redacted]

the dynamic range used by the image (255 for an 8-bit image). *Id.*, col. 4, lines 66–68. Y_{IN} is the original intensity value of the input pixel. *See id.*, col. 4, lines 56–65. Y_{OUT} is the transformed intensity value for the input pixel. *Id.*, col. 4, line 68–col. 5, line 15. By successively processing each pixel in an image in the manner described above, the invention disclosed in the ’381 patent transforms the input image. *Id.*, col. 2, lines 54–68, col. 4, line 68–col. 5, line 15.

1. Claim 1 of the ’381 patent.

Claim 1 of the ’381 patent claims a system for transforming an image as described above. Claim 1 is an independent claim and includes a preamble and two means-plus-function claim elements. *Id.*, col. 7, line 60–col. 8, line 20. Polaroid has put forth its proposal for construing terms found in the preamble if the Court holds that the preamble is a limitation. *See* J.A. Ex. D, Joint Claim Construction Statement — Corrected. Claim 1 under Polaroid’s proposed claim construction is below:

> A system for [*successively transforming*] [*electronic data received in a successive series of signals providing pixel information, such as color, luminance, or chrominance values*], [*each signal being associated with a value that lies within a range of possible values bounded by definite limits*] and corresponding to one of a plurality of succeeding pixels which collectively define an image, said system comprising:
>
> means for [*calculating an intermediate value for*] [*signals providing pixel information, such as color, luminance, or chrominance values*] corresponding to selected pluralities of pixels and providing an [*signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value*] for each said plurality of pixels so averaged; and
>
> means for selecting one of a plurality of different [*functions that transform an input signal*] for the [*signal providing pixel information, such as color, luminance, or chrominance value*] for each of the succeeding pixels in a manner whereby each [*function that transforms an input signal*] is selected as a function of the [*signal providing pixel information, such as color, luminance, or chrominance value*] for one pixel and the [*signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value*] for the select plurality of pixels containing said one pixel and for subsequently transforming the [*signal providing pixel information, such as color, luminance, or chrominance value*] corresponding to each pixel by the [*function that transforms an input signal*] selected for that pixel wherein said selecting and

[redacted]

> transforming means further operates to select said [*function that transforms an input signal*] as a function of the [*ratio of that calculated intermediate value over a value that lies within the range of possible values*] such that the ratio increases in correspondence with the increase in the value of the [*signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value*].

See id. Polaroid contends that the function of the first means-plus-function claim element — the "means for averaging" — is

> calculating an intermediate value for signals providing pixel information, such as color, luminance, or chrominance values]corresponding to selected pluralities of pixels and providing an [signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value for each said plurality of pixels so averaged.

See id. The corresponding structure is a block average or low pass filter or equivalents thereof.

The function of the second means-plus-function claim element — the "means for selecting and transforming" limitation — is:

> selecting one of a plurality of different functions that transform an input signal for the signal providing pixel information, such as color, luminance, or chrominance value for each of the succeeding pixels in a manner whereby each function that transforms an input signal is selected as a function of the signal providing pixel information, such as color, luminance, or chrominance value for one pixel and the signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value for the select plurality of pixels containing said one pixel and for subsequently transforming the signal providing pixel information, such as color, luminance, or chrominance value corresponding to each pixel by the function that transforms an input signal selected for that pixel wherein said selecting and transforming means further operates to select said function that transforms an input signal as a function of the ratio of that calculated intermediate value over a value that lies within the range of possible values such that the ratio increases in correspondence with the increase in the value of the signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value.

See id.

The corresponding structure is the algorithm disclosed in the '381 patent specification: $Y_{OUT} = Y_{MAX}(Y_{IN}/Y_{MAX})^{\gamma}$, where $\gamma=(1+C)^{(Av/M-1)}$ and equivalents thereof. *See id*. In this equation, Y_{OUT} is the transformed pixel value and Y_{MAX} is the maximum value of the dynamic

[redacted]

range used by the image, which is 255 for an 8-bit image. C is a constant that is chosen based on the desired amount of correction. A_v is the average value calculated by the averager **12**. M is a number within the dynamic range of the image, which is 0–255 for an 8-bit image. *See id.*

2. Claims 2 and 3 of the ’381 patent.

Claim 2 is dependent on Claim 1 and Claim 3 is dependent on Claim 2. J.A. Ex. A, ’381 Pat., col. 8, lines 21–40. Claims 2 and 3 under Polaroid’s proposed claim construction are as follows:

> 2. The system of claim 1 wherein said selecting and transforming means is responsive to a[] [*signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value*] indicative of low scene light intensity levels for transforming the [*signals providing pixel information, such as color, luminance, or chrominance value*] to provide a higher contrast to those [*signals providing pixel information, such as color, luminance, or chrominance value*] corresponding to pixels having the lowest scene light intensity levels and is further responsive to a[] [*signal providing pixel information, such as a color, luminance, or chrominance value of calculated intermediate value*] indicative of high scene light intensity levels for transforming the [*signals providing pixel information, such as color, luminance, or chrominance value*] to provide a higher contrast to those [*signals providing pixel information, such as color, luminance, or chrominance value*] corresponding to pixels having the highest scene light intensity levels.
>
> 3. The system of claim 2 wherein said selecting and transforming means further operates to select said transfer function as a function of a determined constant whose value corresponds to the amount of contrast provided in those areas of higher contrast provided by said select transfer function.

See J.A. Ex. D, Joint Claim Construction Statement — Corrected. Claim 3 further defines the “means for selecting and transforming” limitation found in Claim 1 and thus, the function is the same as described with respect to Claim 1 with the following addition: “to select said transfer function as a function of a determined constant whose value corresponds to the amount of contrast provided in those areas of higher contrast provided by said select transfer function”. *Id*. The structure associated with this additional function is the disclosed algorithm that applies a constant C. *Id*.

[redacted]

C. HP Contends That Eight References Render Claims 1–3 Of The ’381 Patent Obvious.

HP contends that the following references each contain every element of the preamble and the means for averaging required by Claim 1: (i) Digital Image Processing by R.C. Gonzalez and P. Wintz, (Addison-Wesley 1987) (“Gonzalez”) (Ex. A); (ii) U.S. Patent No. 4,654,710 to Christian J. Richard (“Richard”) (Ex. B); (iii) Digital Image Enhancement and Noise Filtering by Use of Local Statistics by Jong-Sen Lee, (IEEE Trans. on Pattern Analysis and Mach. Intelligence, Vol. PAMI-2, No. 2, pp. 162–68, March 1980) (“Lee”) (Ex. C); (iv) U.S. Patent No. 4,528,584 to Mohammed S. Sabri (“Sabri”) (Ex. D); (v) Feature Enhancement of Film Mammograms using Fixed and Adaptive Neighborhoods by R. Gordon and R.M. Rangayyan (Applied Optics, 1984, 23(4): 560–64) (“Rangayyan”) (Ex. E); (vi) U.S. Patent No. 4,789,933 to Victor C. Chen and Mike M. Tesic (“Chen”) (Ex. F); and (vii) Real-Time Adaptive Contrast Enhancement by P.M. Narendra and R.C. Fitch (IEEE Transaction on Pattern Analysis and Machine Intelligence, Vol. PAMI-3, No. 6, pp. 655–61, Nov. 1981) (“Narendra”) (Ex. G). HP contends that the Gonzalez algorithm[2] (Ex. H) teaches the final element of Claim 1 — the means for selecting and transforming. Thus, HP contends that any of the references when combined with the Gonzalez algorithm render Claim 1 obvious.

HP contends that any one of Gonzalez, Richard, Rangayyan, Lee or Narendra when combined with the Gonzalez algorithm render Claim 2 obvious under § 103. And, HP contends that any one of Gonzalez, Richard, Lee, or Narendra when combined with the Gonzalez algorithm render Claim 3 obvious under § 103.

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[2] The Gonzalez algorithm is the Image Display Subroutines presented in Appendix A, pages 451–455, of the Gonzalez text found in Ex. A.

[redacted]

None of the references identified by HP teaches or even suggests that contrast can be enhanced in portions of an image that are either too dark or too light by using a gamma function that relies on the ratio of the local mean to a value within the dynamic range of the image as in the following relationship: $\gamma=(1+C)^{(Av/M-1)}$. In addition, none of the references teaches or suggests that the gamma function can then be used to determine an output pixel value according to the following relationship: $Y_{OUT} = Y_{MAX}(Y_{IN}/Y_{MAX})^{\gamma}$.

1. The Gonzalez Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Gonzalez reference teaches image enhancement techniques that are focused on histogram-processing. Ex. A, Gonzalez, Chapter 4. Histogram processing analyzes an image and counts the number of pixels that represent each possible intensity value. *Id.* at pp. 144–45. It then orders this data from the lowest to the highest intensity value possible. *Id.* If the histogram is uniform, *i.e.*, most of the possible intensity values are represented, histogram processing will not modify the pixels. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 18. If there are more pixels with the same intensity value, which causes the distribution to be skewed, histogram processing will modify the intensity values so that a uniform distribution is accomplished. Ex. A, Gonzalez at p. 147. Typically, stretching, equalization, or probability functions are used. *Id.* at pp. 146–160. Histogram processing amplifies local variations in pixel intensities, meaning it will transform light pixels to a lighter intensity and transform dark pixels so that they become darker, which is the opposite of what is taught in the ’381 patent. *See* Ex. A, Gonzalez at p. 160.

The only other method taught by Gonzalez to enhance contrast in an image relies on a gain factor A(x,y) to amplify local variations in an image. *Id.* at p. 160. The gain factor includes the global mean of the image and the standard deviation of the pixel values computed at a neighborhood centered at (x,y). *Id.* The contrast enhancement scheme taught in Gonzalez adds a portion of the local average back to the transformed pixel value to restore the average intensity

[redacted]

level of the image in the local region. *Id.* Thus, Gonzalez does not teach the use of power-law transformation or gamma curves, which later editions of the same text include at length. *See* Ex. B to Agouris Rebuttal Rpt. at p. 80 (J.A. Ex. C).

2. The Gonzalez Algorithm does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Gonzalez algorithm is a computer subroutine that can be used to print images of size 64 x 64 on a single sheet of line-printer paper. Ex. A, Gonzalez at p. 10; Ex. H, Gonzalez Algorithm at p. 451. There are only two objectives of the Gonzalez algorithm: (1) to convert character data ranging from 0 to 9 and A to V to integer data ranging from 0 to 31; and (2) to display the image on a line printer by using the integer data to generate gray levels by overstriking characters on a standard line printer. Ex. A, Gonzalez at p. 10; Ex. H, Gonzalez Algorithm at pp. 451, 452.

The subroutine used to display images on a line printer, “DSP”, converts one of 32 integer values to one of 32 gray levels. Ex. H, Gonzalez Algorithm at p. 452. The DSP subroutine includes four equations, each called “FLEV”, for converting the integer values to gray levels. *Id.* at p. 454. In each case, the gray level is not determined using any local characteristics of the pixel being converted. Also, the Gonzalez algorithm does not teach any contrast enhancement techniques. Thus, the Gonzalez algorithm cannot teach the specific contrast enhancement scheme claimed in the ’381 patent.

3. The Richard Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Richard reference teaches a contrast amplifier for video images. Ex. B, Richard, Abstract. Specifically, it teaches a contrast amplifier that transforms an input pixel using the following relationship: output = Y_{ij}*M_v/M_g *K, where Y_{ij} is the input pixel value, M_v is the local mean, M_g is the global mean, and K is a constant. *Id.*, col. 5, lines 60–61. The contrast amplifier

[redacted]

taught in Richard controls the level of enhancement provided to each pixel using the ratio of the local mean to the global mean, M_v/M_g. *Id.*, col. 1, lines 42–47. In this way, the contrast amplifier will either reduce the brightness of the current pixel in order to bring it close to the value of black or increase the brightness in order to bring it close to the value of pure white. *Id.*, col. 5, line 62–col. 6, line 3. The advantage of the invention taught in Richard over prior art is that the contrast amplifier taught in Richard will not enhance noise in video images. *Id.*, col. 1, lines 35–39. Thus, the teachings of Richard are directed to enhancing contrast without amplifying noise and not to the dynamic transformation of contrast on a pixel-by-pixel basis claimed in the ’381 patent.

4. The Lee Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Lee reference teaches nonrecursive image enhancement techniques that do not require any kind of transform. Ex. C, Lee Abstract, p. 165. Specifically, Lee describes how linear gray level stretching can be used to enhance contrast in an image using the following algorithm: $x'_{ij} = g(m_{i,j}) + k(x_{ij} - m_{ij})$, where x'_{ij} is the output pixel value, $g(m_{i,j})$ is the gray level rescaling function, k is the gain factor, and m_{ij} is the local mean. *Id.* at p. 166. Lee teaches the use of a gain factor, k, that weights the relative contributions of the rescaling function $g(m_{i,j})$ and the difference between the pixel value and the local mean, $(x_{ij} - m_{ij})$. *Id.* The gain factor k is the ratio of a preselected amount of contrast desired between a pixel and its neighbors to the actual contrast present for the selected pixel. *Id.* In addition, depending on the value of the gain factor, the image will either be sharpened or smoothed. *Id.* Thus, the teachings of Lee are directed to a gain-based approach to image enhancement and not the power-law transformation claimed in the ’381 patent.

[redacted]

5. The Sabri Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

Rather than enhancing contrast in an image, Sabri teaches how to preserve the original contrast using bilevel coding. Ex. D, Sabri, col. 1, lines 33–35. Bilevel coding involves comparing the intensity value of the pixel with a threshold value and, depending on whether or not it exceeds the threshold, assigning a corresponding output signal to either a high or low state. *Id.*, col. 1, lines 25–29. Sabri teaches that its bilevel coding process will reduce the required storage capacity or bandwidth needed to transmit video signals. *Id.*, Abstract.

In Sabri, the appropriate threshold value is calculated using two signals: (i) a signal proportional to the luminance component of the color video signal; and (2) a signal proportional to the chrominance component of the color video signals. *Id.*, col. 2, lines 4–13. The proportional luminance component, φ, is a weighted constrained average and is derived in the following manner: $\varphi_{ij}= a_{nm}*X_{i-nj-m}$, where a_{nm} is a weighting coefficient and X_{i-nj-m} is the pixel value preceding the particular element being encoded. *Id.*, line 25; col. 3, lines 46–47. The chrominance-proportional signal, C, for any given pixel is used to derive a contrast enhancement factor, γ, in the following manner: $\gamma = \alpha + \beta*|C|$. *Id.*, col. 2, line 34. α and β are constants. *Id.*, line 36. The threshold value B for any given pixel is then computed as: $B = \gamma + (1-2\gamma/R)* \varphi$, where γ is the contrast enhancement factor and R is the maximum range of the video signal, which is 256 for an 8-bit digital signal. *Id.*, line 40. Thus, Sabri does not teach a contrast enhancement scheme that teaches or suggests the power law transformation claimed in the ’381 patent.

6. The Rangayyan Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Rangayyan reference teaches digital techniques for enhancing features in film mammograms. Ex. E, Rangayyan at p. 560. There are three steps included in the Rangayyan

[redacted]

method: (1) acquiring the digital image of the mammogram using two images acquired at different illumination levels and generating a composite digital image, *id.* at p. 561; (2) applying a pixel operator to the image that performs contrast enhancement according to a specified function, i*d.* at p. 560; and (3) transforming the pixel values to the display range of 0–255 using the following formulas: $p'' = 255\,(p' - min)/(max - min)$ for positive mode and $p'' = 255\,(max - p')/(max - min)$ for negative mode. *Id.* at p. 561.

The pixel operator in the Rangayyan reference enhances contrast by first defining the local contrast between a pixel p and the average of its eight neighbors in a 3x3 pixel matrix centered at p as follows: $C = |p-a|/(p+a)$. *Id.* The contrast measure C will vary between 0 and 1. *Id.* Rangayyan then teaches that the next step is to enhance the contrast measure to a new value C′ using the formula $C' = \sqrt{C}$. *Id.* The enhanced measure C′ will also vary between 0 and 1. *Id.* The new pixel value p′ is derived as $p' = a(1+C')/(1-C')$ if $p \geq a$, or $p' = a(1- C')/(1+ C')$ if $p < a$. *Id.* Thus, the Rangayyan reference does not teach the power law transformation claimed in the ’381 patent.

7. The Chen Reference does not teach the contrast enhancement scheme claimed by the ’381 patent.

The Chen reference is directed to fractal model based image processing. Ex. F, Chen, title page. The image processing is performed by selecting a self-similarity value for each pixel in an image. *Id.*, col. 2, lines 55–56. The self-similarity factor is derived using a convolution function. *Id.*, col. 6, lines 18–19. The combination of the pixel value being transformed and the average of its surrounding pixel values is weighted according to the corresponding self-similarity factor such that for enhancement, the more similar the pixel value is to its surrounding contiguous pixel values, the more heavily the pixel value is weighted. *Id.*, lines 62–67. The less similar the pixel value is to its surrounding contiguous pixel values, the more heavily the

[redacted]

variation value is weighted. *Id.*, col. 2, line 67–col. 3, line 2. The actual amount of enhancement is determined according to the following function: $I'(i,j) = G(i,j)[I(i,j) - \bar{I}(i,j)] + \bar{I}(i,j)$, where $I'(i,j)$ is the improved image value for each pixel, G(i,j,) is a transfer function, which varies between 1 and 2 for enhancement, and $\bar{I}(i,j)$ is the mean pixel neighborhood value. *Id.*, col. 7, lines 36–45, col. 6, line 65–col. 7, line 5. Thus, Chen does not teach the power law transformation claimed in the '381 patent.

8. The Narendra Reference does not teach the contrast enhancement scheme claimed by the '381 patent.

The Narendra reference teaches a recursive filter approach to simplify real-time implementation of an adaptive contrast enhancement scheme for imaging sensors. Ex. G, Narendra at p. 655. A recursive architecture relies on an iterative process to achieve the desired transformation. *See* J.A. Ex. C, Agouris Rebuttal Rpt. at p. 29. Narendra teaches away from the use of non-recursive algorithms like that claimed in the '381 patent because a recursive approach is "very simple" to achieve with hardware. Ex. G, Narendra at p. 657.

In addition, Narendra's algorithm is a simple local transformation routine that uses a local mean and a local standard deviation to calculate the output pixel value in accordance with the following function: $\hat{I}_{ij} = G_{ij}(I_{ij} - M_{ij}) + M_{ij}$. *Id.* at p. 656. $\hat{I}_{ij}$ is the transformed intensity value, G_{ij} is the local gain, I_{ij} is the original pixel value, and M_{ij} is the local mean computed on a local area surrounding the pixel to be transformed. *Id.* G_{ij} is derived from the following:

$G_{ij} = \alpha * \frac{M}{\sigma_{ij}}$, $0<\alpha<1$. *Id.* In this equation, M is the global mean and σ_{ij} is the local standard deviation computed on a local area surrounding the pixel being transformed. *Id.* Thus, Narendra teaches a contrast enhancement scheme that first subtracts the local mean from the image at every point. *Id.* A variable gain is then applied to the difference to amplify local variations. *Id.*

[redacted]

A portion of the local mean is then added back to restore the subjective quality of the image. *Id.* Thus, Narendra does not teach the power law transformation claimed in the '381 patent.

ARGUMENT

I. THE APPLICABLE LAW.

A. The Law Governing Summary Judgment.

Summary judgment under 35 U.S.C. § 103 should be granted if the pleadings, depositions, answers to interrogatories, and admissions on file, together with affidavits, if any, show that there is no genuine issue as to any material fact and that Polaroid should be granted judgment as a matter of law. Fed. R. Civ. P. 56(c); *see also Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 247–48 (1986) . The mere existence of some alleged factual dispute between the parties will not defeat an otherwise properly supported motion for summary judgment; the requirement is that there be no genuine issue of material fact. *Id.* A primary purpose of summary judgment is to "isolate and dispose of factually unsupported claims or defenses." *Celotex Corp. v. Catrett*, 477 U.S. 317, 323-24 (1986). There is no issue for trial unless there is sufficient evidence favoring the non-moving party for a jury to return a verdict for that party. *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 249-50 (1986). If the evidence is merely colorable, or is not significantly probative, summary judgment may be granted. *Id.* Thus, HP must do more than merely raise some doubt as to the existence of a fact; HP must provide evidence that would be sufficient to require submission to the jury of the dispute over the fact. *Avia Group Intern., Inc. v. L.A. Gear California, Inc.*, 853 F.2d 1557, 1560 (Fed. Cir. 1988) (quotations omitted).

B. The Law Governing Obviousness.

A patent is presumed valid. 35 U.S.C. § 282. Therefore, an alleged infringer seeking to invalidate a patent on obviousness grounds must establish its obviousness by facts supported by

[redacted]

clear and convincing evidence. *Kao Corp. v. Unilever U.S., Inc.*, 441 F.3d 963, 968 (Fed. Cir. 2006). Under 35 U.S.C. § 103, a patent's claim is invalid for obviousness if the claimed invention would have been obvious at the time the invention was made to a person having ordinary skill in the art based on the prior art available. *See* 35 U.S.C. § 103 (a). Obviousness is a question of law, which depends on the following factual inquiries, called the *Graham* factors: 1) the scope and content of the prior art; 2) the differences between the art and the claims at issue; 3) the level of ordinary skill in the art; and 4) objective evidence of nonobviousness. *See KSR Int'l Co. v. Teleflex, Inc.*, __ U.S. ___, ___, 127 S.Ct. 1727, 1734 (2007).

In order to combine prior art references to show obviousness, it is "important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements" in the manner claimed. *Id.* at 1741. "[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art . . . ." *Id.* at 1731. This is so because "inventions [in most, if not all, instances] rely upon building blocks long since uncovered, and claimed discoveries almost necessarily will be combinations of what, in some sense, is already known." *Id.* In addition to showing that a person of ordinary skill in the art would have had a reason to attempt to make the composition, an alleged infringer must demonstrate that such a person "would have had a reasonable expectation of success in doing so." *PharmaStem Therapeutics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1360 (Fed. Cir. 2007); *see also Takeda Pharm. Co. Ltd. v. Teva Pharm. USA, Inc.*, Civ. No. 06-033-SLR, 2008 WL 839720, *12 (March 31, 2008).

II. CLAIMS 1–3 OF THE '381 PATENT ARE NOT OBVIOUS.

Claims 1 through 3 would not have been obvious to one of ordinary skill in the art at the time of the invention in view of HP's alleged prior art because the combination of the proffered references would not result in the invention claimed in Claims 1–3. In each case, HP seeks to

combine the Gonzalez algorithm, a computer subroutine used to print images on a standard line printer, with various image enhancement techniques in an attempt to invalidate Claims 1–3 of the '381 patent. A person of ordinary skill in the art, however, would not have an apparent reason to combine HP's references in this way nor would he or she have a reasonable expectation of success in doing so. The art would not have suggested to a person having ordinary skill that it was even possible to dynamically enhance electronic information signals using the claimed transfer functions.

A. The Scope And Content Of The Prior Art.

The Gonzalez algorithm is not within the scope and content of the prior art. To determine whether a reference is within the scope and content of the prior art, the Court must first determine if the reference is within the field of the inventor's endeavor. *In re Kahn*, 441 F.3d 977, 986–87 (Fed. Cir. 2006); *The B.F. Goodrich Co. v. Aircraft Braking Sys., Corp.*, Nos. C.A. 91-CV-48-SLR, C.A. 91-515-SLR, 1994 WL 16019986, *21 (Nov. 10, 1994) (quoting *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve*, 796 F.2d 443, 449 (Fed. Cir. 1986)). If it is not, the Court next considers whether the reference 'is reasonably pertinent to the problem with which the inventor was concerned." *Kahn*, 441 F.3d at 987.

The invention of the '381 patent is directed to systems and methods for enhancing images by increasing or decreasing contrast in selected portions of an image that may be overlit or underlit on a pixel-by-pixel basis. J.A. Ex. A, '381 Pat., col. 1, lines 45–57. Therefore, the field of endeavor for the '381 patent must be directed to enhancing an image. The particular problem that the inventors were trying to solve is how to dynamically increase or decrease contrast and brightness in selected portions of a scene that may be overlit or underlit. *Id.*, col. 1, lines 45–50.

The Gonzalez algorithm that HP relies upon to teach the "means for selecting and transforming" limitation is not within the scope of the prior art because it is not within the field

[redacted]

of the inventors' endeavor. The Gonzalez algorithm is merely a computer subroutine that can be used to print images of size 64 x 64 on a single sheet of line-printer paper. Ex. A, Gonzalez at p. 10; Ex. H. Gonzalez algorithm at p. 451. The Gonzalez algorithm determines how to reproduce gray levels in images by overstriking characters on a line printer. *Id.* at 452. The Gonzalez reference — an introductory text on digital image processing — does not recognize that the Gonzalez algorithm is instructive on image enhancement because it fails to mention the algorithm in relation to any of the image enhancement techniques it teaches.

Furthermore, the Gonzalez algorithm is not reasonably pertinent to the inventors' problem. The Gonzalez algorithm provides no teachings on how to increase or decrease contrast and brightness in selected portions of a scene that may be overlit or underlit. In fact, HP's expert, Dr. Rangayyan, agrees that the Gonzalez algorithm is a global transformation scheme, *i.e.*, the same factor is applied to each pixel in the image, to determine which gray level to assign to the input integer value. *Id.* at p. 454:

> Q. Prior to performing the modifications that you describe in your supplemental expert report, isn't it true that the Gonzalez algorithm is a global transformation scheme?
>
> A. If you take it on the face of what is present on page 454 or in this Exhibit 682, I agree with you. But I have mentioned that one who knows image processing could easily modify that method to include local variables.

Ex. I, R. Rangayyan Dep. Tr. at p. 198, line 27–p. 199, line 8.

There are only two objectives of the Gonzalez algorithm, neither of which are directed to the field of endeavor or particular problem the inventors were attempting to solve. The first objective of the Gonzalez algorithm is to convert character data ranging from 0 to 9 and A to V to integer data ranging from 0 to 31. Ex. H, Gonzalez algorithm at p. 451. Both the character data and the integer data represent 32 shades of gray. *See* Ex. I, R. Rangayyan Dep. Tr. at p. 107, lines. 15–18; p. 107, line 23–p. 108, line 2. The second objective of the Gonzalez

Algorithm is to display the image on the line printer by using the integer data to generate gray levels using the overstrike capability of a standard line printer. Ex. A, Gonzalez at p. 10; Ex. H, Gonzalez algorithm at p. 452. One of skill in the art would not reasonably have expected to solve the problem of how to dynamically increase or decrease contrast and brightness in selected portions of a scene that may be overlit or underlit by considering a reference teaching how to use a standard printer's overstrike capability to print low-resolution images.

B. The Differences Between The Prior Art[3] And Claims 1–3.

As explained above, HP has advanced obviousness arguments with respect to Claims 1–3 by combining the Gonzalez algorithm with eight references. None of these references either alone or in the combination HP describes, suggest a means for selecting and transforming that uses a power law function to enhance a pixel in the manner claimed by Claims 1–3. None of these references either alone or in the combination HP describes, suggest a system that would inherently produce such means.

1. There are significant differences between Claims 1–3 and the Gonzalez algorithm.

The Gonzalez algorithm does not teach the structure corresponding to the "means for selecting and transforming" element in Claim 1. As explained previously, the Gonzalez algorithm is not within the scope of the prior art and cannot be used to render claims of the '381 patent obvious. But, even if the Gonzalez algorithm were within the scope of the prior art, there are significant differences between it and the means for selecting and transforming taught by Claims 1–3.

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3 For purposes of this motion, Polaroid will treat the remaining references identified by HP as falling within the scope and content of the prior art.

[redacted]

The Gonzalez algorithm teaches one of ordinary skill in the art to print images on standard line-printers by overwriting character data. Ex. A, Gonzalez at p. 10. The teachings of the Gonzalez algorithm provide no guidance on solving the problem of how to enhance portions of an image that are either too light or too dark while leaving the remaining portions of the image intact. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 18. No image enhancement is involved in the Gonzalez algorithm. *Id.* Instead, the Gonzalez algorithm teaches four ways to assign gray levels to the overstrike capability of a line printer. The Gonzalez algorithm selects one of four functions for "FLEV" to assign gray levels. Which particular function is selected depends on the gray level scale translation variable, LAW, selected. Ex. H, Gonzalez algorithm at p. 452. After making substitutions required by the subroutine, the four functions are as follows:

- $\text{FLEV} = Y_{min} + (Y_{in}-1) * ((Y_{max}-Y_{min}+1)/32) + 0.5$, *id.* at p. 454, line 110;
- $\text{FLEV} = (\sqrt{\text{Ymin}} + (Y_{in} - 1)) * ((\sqrt{\text{Ymax}} - \sqrt{\text{Ymin}})/32)^2 + 0.5$, *id.* at line 120;
- $\text{FLEV} = Y_{min} + (Y_{max} - Y_{min})/\text{ALOG}(33) * \text{ALOG}(\text{FLOAT}(Y_{in})) + 0.5$, *id.* at line 130; and
- $\text{FLEV} = Y_{max} * \text{EXP}(-(1.0/\text{GN}) * \text{ALOG}(Y_{max}/T) * (32 - Y_{in})) + 0.5$, where $T = Y_{min}$ or 1, *id.* at line 140.

FL is the minimum gray level in the input image. *Id.* at pp. 453, 454. I is the input pixel value. FH is the maximum gray level in the input image. *Id.* at pp. 453, 454. GN equals 32. *Id.* at p. 454. Each of these equations for "FLEV" is a global scaling function, not a local contrast enhancement method. Therefore, "FLEV" assigns gray levels to each pixel in the image by scaling the input pixel values equally. Ex. H, Gonzalez algorithm at p. 454.

"FLEV" differs from the structure corresponding to the "means for selecting and transforming" limitation in at least three key ways. First, "FLEV" does not enhance the contrast of an incoming pixel. Claims 1–3 of the '381 patent, on the other hand, are directed to a system that continuously enhances pixels. J.A. Ex. A, '381 Pat., col. 7, lines 61–66.

[redacted]

Second, none of the equations for FLEV depends on the local average of the pixel being transformed to determine the output pixel value. *See* Ex. H, Gonzalez algorithm at p. 454. Dr. Rangayyan, HP's expert, agrees that the functions in the Gonzalez algorithm are global functions that are applied uniformly to each pixel in the image. *See* Ex. I, R. Rangayyan Dep. Tr. at p. 198, line24–p. 199, line 8. In contrast, the '381 patent teaches using the local average in the following power-law function to enhance contrast in an image on a pixel-by-pixel basis:

$$Y_{out} = Y_{max}*(Y_{in}/Y_{max})^{\gamma},\ \gamma=(1+C)^{(Av/M-1)}$$

Y_{out} is the output pixel value, Y_{max} is the maximum value of the dynamic range, and Y_{in} is the input pixel value. Gamma (γ) is the function used to select a transformation function for an incoming pixel. A_v is the local average of the pixels around the input pixel value (a calculated intermediate value of surrounding pixel intensities), and M is a value within the dynamic range. J.A. Ex. D, Joint Claim Construction Statement — Corrected.

Third, none of the equations for "FLEV" use a value within the dynamic range of the output image in any capacity, and certainly not to determine the manner of transformation as in the '381 patent. The denominator of the ratios found in each equation for "FLEV" is at least 32. The dynamic range of the image processed in the DSP subroutine , however, ranges from 0 to 31. The Gonzalez algorithm shows the characters used in the DSP subroutine to obtain "the 32 gray levels" in Fig. A.1 on page 453 of the Gonzalez algorithm. Ex. H, Gonzalez Algorithm at p. 453. In addition, the subroutine specifically sets the gray level to 32 shades of gray corresponding to integer values of 0 to 31 in the first nine lines of the DSP subroutine shown on page 454 of the Gonzalez algorithm. Thus, the maximum value for any pixel in the output image in the Gonzalez algorithm is 31. Consequently, neither 32 nor 33 are values within the dynamic range of the Gonzalez algorithm as required by Claim 1.

2. There are significant differences between Claims 1–3 and Gonzalez.

Gonzalez text relates to histogram processing that is very different from the local contrast enhancement taught in the ’381 patent. Histogram processing amplifies local variations in pixel intensities, meaning it will transform light pixels to a lighter intensity and transform dark pixels so that they become darker. *See* Ex. A, Gonzalez at p. 160.

In contrast, the ’381 patent uses a power law function, not uniform distributions, to enhance pixels. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 18. The ’381 patent will enhance light pixels so that they will become darker, and it enhances dark pixels so that they will become lighter. *Id.* Thus, the histogram processing taught in Gonzalez teaches the opposite of what is taught in the ’381 patent. *Id.*

The only transfer function taught in Gonzalez that is not histogram processing is described in equation 4.2-14 on page 160 of Gonzalez. This transfer function does not teach the function of the means for selecting and transforming. Rather, Gonzalez teaches one of ordinary skill in the art to transform an input pixel by taking the difference between the input pixel value and the average of neighboring pixels multiplied by a gain factor and then adding that proportion to the average. Ex. A, Gonzalez at p. 160. Gonzalez does not employ a power-law transformation like the “means for selecting and transforming” limitation in Claim 1 and is not the same as a gamma curve. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 19. Indeed, Gonzalez does not discuss power-law transformation or gamma curves, although a later edition of the same text discuss these technologies. *See* Ex. B to Agouris Rebuttal Rpt. (J.A. Ex. C). This later edition demonstrates that, in 1987, Gonzalez did not teach power-law transformations and gamma curves. Moreover, the 1987 edition of Gonzalez recognizes that more sophisticated image enhancement techniques would likely come from other sources and that its teachings were to only serve as a foundation. Ex. A, Gonzalez at p. 200.

The Gonzalez transfer function also differs from the means for selecting and transforming of Claim 1 in its use of a gain factor A(x,y) shown in equation 4.2-15. *Id.* at p. 160. The gain factor includes a global term M, which is the global mean of the image. *Id.* This alters the local character of the image enhancement scheme, making it dependent on a global measure which affects local calculations. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 19. In contrast, the ’381 patent teaches an image enhancement process that is solely dependent on local measures. *Id.*

Moreover, the constant k used in the transformation equation in Gonzalez takes values from 0–1 and acts as a scaling factor. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 20. There is no information in Gonzalez as to the way this constant is selected and how its value is determined in every case. *Id.* Gonzalez teaches that “application of a local gain factor A(x,y) to the difference between f(x,y) and the local mean amplifies local variations”. Ex. A, Gonzalez at p. 160. As a result, the transformation taught by Gonzalez results in amplifying intensity values by making dark areas darker and light areas lighter, which teaches away from what is disclosed in the ’381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 20.

3. There are significant differences between Claims 1–3 and Richard.

Richard teaches a contrast amplifier for video images, but its system is very different from that taught in the ’381 patent. There is nothing in Richard suggesting the possibility of successively enhancing electronic image data. Richard teaches that a “sequence” of luminance values of a field is received at the input terminal. Ex. B, Richard, col. 2, lines 26–27. This “sequence” does not refer to successive pixels. Richard teaches that a video image consists of two interlaced fields that are processed as two independent images. *Id.*, lines10–12. Thus, Richard teaches transforming pixels in various parts of the image concurrently and teaches away from successively enhancing the entire image, pixel by pixel. *See id.*, col. 2, lines 10–12.

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In addition, Richard uses both the global mean and the local mean to determine the amount of enhancement needed at any particular pixel. *Id.*, col. 2, lines 15–24. Using two means in this way is a different method of transforming a pixel than the digital image enhancement taught in the ’381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 21. Richard transforms an input pixel using the following relationship: output = $Y_{ij}*M_v/M_g *K$, where Y_{ij} is the input pixel value, M_v is the local mean, M_g is the global mean, and K is a constant. Ex. B, Richard, col. 5, lines 60–61. Richard’s means for transforming will not achieve the same result as the ’381 patent’s means for selecting and transforming for two reasons. First, Richard does not select a transfer function (γ) in the same way that is taught in the ’381 patent. Richard uses the local mean directly, whereas the ’381 patent uses it in the exponent of γ, which is an exponent itself in the means for transforming. Thus, the local mean used in the Richard algorithm will have a greater impact on the transformation of pixels. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 21. Second, Richard uses a global mean to scale the amount of transformation needed and the ’381 patent does not. *Id.* In addition, the result of the contrast enhancement process taught in Richard differs drastically from that claimed in the ’381 patent. Richard teaches that the new pixel value will either reduce the brightness of the current pixel in order to bring it close to the value of black or increase the brightness in order to bring it close to the value of pure white. Ex. B, Richard, col. 5, line 62–col. 6, line 3. The ’381 patent, however, determines the amount of transformation based on the average pixel intensities near the pixel being transformed.

The constant C in the ’381 patent appears in the base of the function used to select the transfer function according to the following algorithm: $(1+C)^{Av/M-1}$. Increasing C in the manner taught by Claim 3 impacts the shape of the curves used to determine the amount of contrast needed in particular areas of the image so that more contrast is provided to areas of higher

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contrast than in other areas of the image. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 22. Changing K in Richard will not impact the amount of contrast provided by the system in the same way because the constant K disclosed in Richard is a scaling factor that is used to scale the output pixel value. *Id.* The constant K in Richard is not used to determine which transformation curve to apply to a particular pixel. *Id.* Therefore, as the constant K in Richard is increased, the output pixel value will increase equally at every pixel in an image. *Id.* For this additional reason, Richard does not disclose the "means for selecting and transforming" limitation of Claim 3.

4. There are significant differences between Claims 1–3 and Lee.

Lee is directed to an image enhancement technique that uses linear gray level stretching to enhance the pixels in an image. Ex. C, Lee at p. 166. The teachings in Lee differ from the '381 patent in three ways. First, Lee teaches away from "successive" pixel enhancement — it teaches that "each pixel can be processed separately without waiting for its neighboring pixels to be processed." *Id.* at p. 165. In contrast, the '381 patent teaches a pixel-by-pixel enhancement algorithm that relies on the value of neighboring pixels to enhance each pixel.

Second, Lee teaches a contrast enhancement scheme that will sharpen an image as if passed through a high-pass filter under certain conditions. *Id.* at p. 166. In contrast, Claims 1–3 teach that the image is smoothed by passing through a low-pass filter or block averager. The '381 patent never teaches the use of a high-pass filter to enhance contrast. Moreover, Lee teaches the use of a gain factor that amplifies local variations of intensities, which translates to dark areas becoming darker and light areas becoming lighter. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 23. As explained previously with respect to Gonzalez and Richard, this type of enhancement scheme is in direct contradiction to the teachings of the '381 patent.

Third, Lee teaches linear gray level stretching to enhance contrast in an image. Ex. C, Richard at p. 166, Eqns. (4) and (5). The transformation formula: $x'_{ij} = m_{ij} + k(x_{ij} - m_{ij})$, where k

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= $\sqrt{(vij/vorig)}$ does not even suggest the power law transformation claimed in Claim 1. "k" is a ratio of standard deviations that shows how the pixel values deviate from the local mean. The value of "k" in Lee is used to scale the impact of the local mean in transforming the pixel value. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 23. Furthermore, k will either sharpen an image or smooth an image depending on its value. *See id.* at p. 24. When it smoothes an image, it will decrease the amount of contrast present in that image. *Id.* Therefore, Lee does not teach a system where increasing a constant increases the amount of contrast enhancement that is performed in areas of the image having higher contrast. *Id.* Moreover, the denominator of the ratio used in Lee is not a number that represents an intensity level, like the denominator, M, used in the '381 patent. *Id.* at p. 23.

It is more than a nontrivial step to move from a linear transformation to a non-linear transformation. *Id.* A non-linear transformation is more complicated to design so that a desired goal is obtained than a linear transformation because the outcome of a non-linear transformation cannot be easily foreseen or predicted. *Id.* In addition, there are many types of non-linear transformations with nothing in common but the fact that they are non-linear. *Id.* Therefore, there is no support for why or how one of ordinary skill in the art would make this leap. *Id.*

5. There are significant differences between Claim 1 and Sabri.

There is no disclosure in Sabri to suggest a process to dynamically transform the pixels in the video signals so that contrast is improved in the light and dark areas of an image. There is no transfer function in Sabri. The only equations in Sabri are those that calculate a luminance-proportional signal from the color video signals and a contrast enhancement factor, which is based on the chrominance signal. *Id.*, col. 2, lines 25, 35. These values are then used to derive a threshold value for each pixel. *Id.*, line 42. The only transformation occurs when the pixel is compared to the threshold value and is either assigned a low or a high value depending on

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whether the pixel is greater than or less than the threshold value. The teachings in Sabri do not suggest the power law transformation curves taught in the ’381 patent.

6. There are significant differences between Claims 1–3 and Rangayyan.

The Rangayyan reference teaches one of skill in the art to estimate a local contrast measure “C” based on the intensity value of the pixel “p” and the average “a” of its eight neighbors and then alters the pixel value “p′” so that a new contrast value “C′” results. Ex. E, Rangayyan at p.561. This approach is different than the contrast enhancement algorithm taught in the ’381 patent because Rangayyan selects the desired contrast and then solves for the new pixel value to be used in order to achieve the desired contrast. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 26. Thus, the teachings in Rangayyan do not disclose a power-law transformation like that taught in the ’381 patent. *Id.* The Rangayyan reference also differs in the way that the contrast enhancement is achieved (*i.e.*, by preselecting a contrast and then enforcing the new pixel value to satisfy this contrast). *Id.* The ’381 patent, on the other hand, calculates new pixel values based on customized gamma curves, with no predetermined level of contrast.

Rangayyan also differs from Claims 1–3 because Rangayyan relies on the average of the eight neighbors surrounding the pixel being transformed and does not include the pixel being transformed in the calculation. Ex. E, Rangayyan at p. 561. The local average used in the means for averaging in Claim 1 requires that the value of the pixel being transformed be included in the average. *See* J.A. Ex. A, ’381 Pat., col. 8, lines 8–10.

In addition, the “contrast measure C” in the Rangayyan reference is a ratio whose numerator is the absolute value of the difference between the input pixel value “p” and the average “a”, and whose denominator is the sum of the intensity values of the input pixel and the average “a”. *See* Ex. E, Rangayyan, p. 561. It is not a ratio of the value of the average electronic information signal to a select proportionate value of the dynamic range of the electronic

information signals. The numerator of "C" is a difference containing the average (not the average itself) and the denominator can accept values outside the image dynamic range. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 27. In addition, "C" is not an intermediate value corresponding to selected pixels in an image — the Rangayyan reference states explicitly that C takes values between 0 and 1 (and thus clearly does not represent an intermediate value corresponding to pixels in the image). Ex. E, Rangayyan, section B, column 1.

In addition, Rangayyan teaches "a simple enhancement function" where the contrast measure $C = \sqrt{(|p - a|/(p + a))}$, where p is the input pixel value and a is the average of the eight neighbors. *Id.* In Rangayyan, there is only one curve associated with this function for each pixel in an image because the function is not a gamma-based function. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 27. The Rangayyan technique does not select a different transformation curve depending on the location of a pixel in an image. *Id.* The curve generated by Rangayyan's contrast measure minimizes gray areas by making dark pixels darker and light pixels lighter. *Id.* Rangayyan's technique of making dark pixels darker and light pixels lighter is important in medical applications where, for example, the light areas of an x-ray should be distinctly different from the dark background of the image. *Id.* at pp. 27–28. In contrast, the '381 patent makes light pixels darker and dark pixels lighter to enhance contrast in an image.

7. There are significant differences between Claim 1 and Chen.

The Chen reference is directed to fractal model based image processing. Ex. F, Chen, title page. The image processing taught in the Chen reference differs significantly from that claimed in the '381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 28–29. The image processing in Chen is performed by selecting a self-similarity by comparing the averaging difference between a given pixel and the pixel values in a first surrounding ring with the averaging difference between the given pixel and the pixel values in a second surrounding ring. This

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function is shown in Figure 2 of the Chen reference for a given pixel i,j and a first ring of radius r=1 and a second ring of radius r=2. Ex. F, Chen, Fig. 2; col. 2, lines 55–56; col. 6, lines 18–19.

The self-similarity value is then used to determine how much weight should be given to the original pixel value in the transformation process. *Id.* at col. 2, line 62–col. 3, line 2. In contrast, the ’381 patent relies on the following algorithm for gamma (γ) to determine the amount of enhancement to provide to each pixel in the image: $\gamma=(1+C)^{(Av/M-1)}$. *See* J.A. Ex. A, ’381 Pat., col. 4, lines 26–56. The average pixel value used in gamma is merely the average of the pixel intensities surrounding and including the pixel being transformed. *Id.*, col. 3, lines 61–67.

The process for calculating the output pixel value also differs in Chen from that taught in the ’381 patent. In Chen, the output pixel I′(i,j) is determined according to the following function: $I'(i,j) = G(i,j)[I(i,j) - \bar{I}(i,j)] + \bar{I}(i,j)$, where I′(i,j) is the improved image value for each pixel, G(i,j,) is a transfer function, which varies between 1 and 2 for enhancement depending on the value of the self-similarity value, and $\bar{I}(i,j)$ is the mean pixel neighborhood value. Ex. F, Chen, col. 7, lines 36–45, col. 6, line 65–col. 7, line 5.

The ’381 patent, on the other hand, determines the output pixel value according to the following relationship: $Y_{OUT} = Y_{MAX}(Y_{IN}/Y_{MAX})^{\gamma}$. In the equation taught in the ’381 patent, there is no weighting of the difference between a given pixel and its local average. Indeed, there is no difference taken between a given pixel and its local average. In addition , the output algorithm in the ’381 patent does not add back in the local average before determining the output pixel value.

8. There are significant differences between Claims 1–3 and Narendra.

Narendra teaches the use of a recursive filter to accomplish real-time LACE. Ex. G, Narendra, p. 655. Indeed, Narendra concedes that the “main contribution of this paper is an

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efficient recursive architecture." *Id.* at p. 656. A recursive architecture is different from the approach taught in the '381 patent because it relies on an iterative process to achieve the desired transformation. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 29. In contrast, the '381 patent does not rely on iterations or any re-calculations of any parameter to enhance pixel values. As a result, the invention of the '381 patent is considered a non-recursive architecture. *Id.* Narendra teaches away from the use of non-recursive algorithms, such as that used in the '381 patent, because a recursive approach is "very simple" to achieve with hardware. Ex. G, Narendra at p. 657.

In addition, Narendra's algorithm is a simple local transformation routine that uses a local mean and a local standard deviation to calculate the output pixel value. *Id.* at p. 656. Narendra does not use a power law function to select the transformation curves. J.A. Ex. C, Agouris Rebuttal Rpt. at pp. 29–30. The use of the global mean in Narendra alters the local character of the approach as it depends on a global measure as well, and therefore Narendra differs fundamentally from the '381 patent. *Id.* at p. 30.

The teachings of Narendra also differ from the invention of the '381 patent because Narendra teaches a gain-based approach that does not consist of a power law transformation as in the '381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 30. The gain factor disclosed in Narendra affects contrast everywhere in the image equally. *Id.* The value of the gain factor does not depend on how dark or how bright the area of the image that contains the pixel being transformed. *Id.* It would be a non-trivial step to provide a constant that adjusted the amount of contrast to provide based on the local characteristics of the image. *Id.*

C. The Level Of Ordinary Skill In The Art.

In considering whether any claim is obvious, a person of ordinary skill in the art at the time of the '381 patent would be have a college degree in a technical field with one to two years experience with digital image enhancement. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 32.

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D. Secondary Considerations Of Non-Obviousness.

Secondary considerations, or objective evidence of non-obviousness may be used to give light to the circumstances surrounding the origin of the subject matter sought to be patented and support the finding that a patent is not obvious. *KSR*, 127 S.Ct. at 1734 (citing *Graham*, 383 U.S. at 17–18). These factors include long-felt demand, failure of others, professional approval, commercial success, commercial acquiescence, and copying. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)(internal citations omitted) .

1. Long-felt demand and failure to solve by others.

Evidence of long-felt demand for the invention and the failure of others to solve the problem addressed by the ’381 patent support Polaroid’s position that that the claims are not obvious. As previously explained, prior to the invention claimed in the ’381 patent, there was a problem obtaining satisfactory image enhancement by applying a single transform function to all pixels in an image. Because there are scenes where the light varies, a transform function that enhances contrast as desired in a bright area of image will not work as well in a dark area of an image. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 32–33. Other scientists have recognized this problem and expressed a desire for a solution. For example, in 1986, Neil Sullivan, C. Durward Rogers, and Steven Daniels recognized the problem of displaying images that have a larger dynamic range than the display medium in an article published in the Journal of Computer Graphics titled, A Tutorial on Developing a Computer-controlled Camera System. *See* Ex. J, Neil Sullivan *et. al*, A Tutorial on Developing a Computer-Controlled Camera System, Computer Graphics, 7–16 (Feb. 1986) (POL 16529–38). They stated that it was impossible to align gamma curves so that the display on the monitor looked the same as the original film. *Id.* at p. 12. In other words, the authors did not believe it was possible to enhance the displayed image so that it mimicked the variations in contrast that were present in the original film. J.A.

[redacted]

Ex. C, Agouris Rebuttal Rpt. at p. 33. The authors attempted to work around the problem by linearizing the gamma curves of the developed pictures. Ex. J at pp. 7–16. They did not come up with the same solution as the inventors of the '381 patent. Instead, they settled on a method that they considered the "next best thing." *Id.* Thus, this article supports the conclusion that there was a long felt need for a solution to the problem of displaying images accurately under varying lighting conditions and a failure of others working in the art to solve it.

2. Professional approval.

HP's expressions of acclaim for its Adaptive Lighting technology, which is the feature that uses the claimed algorithms in HP's accused products[4], is objective indicia that the '381 patent was not obvious at the time the patent application was filed. For example, on HP's website, HP refers to Adaptive Lighting in its printers as "ground-breaking" technology. *See, e.g.*, Ex. K, "Real Life Technologies in HP Photosmart printers and All-in-Ones" (POL 7539015–16). In addition, HP's marketing strategy [redacted] *See* Ex. L, HPPOL_0266121. Moreover, Adaptive Lighting was something that HP wanted [redacted] *See id.* at HPPOL_0266128. Thus, these actions by HP in as late as 2004, which is 15 years after the '381 patent issued, are objective indicia that the '381 patent was not obvious at the time the patent application was filed. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 34.

3. Commercial success.

Beginning with their introduction in 2002, and continuing through the present, HP's accused products have practiced the inventions of Claims 1–3 of the '381 patent. J.A. Ex. C,

[4] See Polaroid's brief in support of summary judgment of infringement to see how HP's accused products incorporating Adaptive Lighting technology infringe Claims 1-3 of the '381 patent.

[redacted]

Agouris Rebuttal Rpt. at p. 34. HP's accused products have been a commercial success in part due to aggressive marketing of the Adaptive Lighting feature as described above in connection with the discussion concerning "professional approval". From 2002 to present, sales have been more than [redacted]. *See id.* Because the success of these products is due to the use of the patented invention in these products, it serves as additional objective indicia that the '381 patent was not obvious at the time the patent application was filed.

4. HP's patent for a similar algorithm.

In 2000, Nathan Moroney, an HP employee, presented a paper titled, "Local Color Correction Using Non-Linear Masking" at the IS&T/SID Eighth Color Imaging Conference. *See* Ex. 45 to Agouris Op. Rpt. (J.A. Ex. B). In this paper, Mr. Moroney presented an algorithm for use in a local-color-correction method that chooses the amount of correction needed for a particular pixel based on the character of the neighboring pixels. *Id.* at POL 617. This algorithm is similar to that taught in the '381 patent and seeks to solve the same problem that the inventors of the '381 patent solved — how to dynamically enhance contrast in the portions of an image that were either overlit or underlit. *See id.*

Moroney Paper	'381 patent
$Output = 255 * \left(\frac{Input}{255}\right)^{\left(2^{\left(\frac{128-Mask}{128}\right)}\right)}$	$Y_{out} = 255*(Y_{in}/255)^{\gamma}, \gamma=2^{(Av/M-1)}$

Also in 2000, Mr. Moroney filed a patent application that led to U.S. Patent No. 6,813,041 that was directed to the contrast enhancement method taught in Moroney's 2000 article[5]. *See id.*, n.16; *see also* Ex. M, U.S. Patent No. 6,813,041 (POL 7238652–64). Mr.

[5] HP did not disclose the '381 patent to the examiner and the examiner did not have the '381 patent before him when evaluating Moroney's patent application that led to the '140 patent.

Moroney's presentation of an algorithm similar to that taught in the '381 patent 11 years after the '381 patent issued is objective indicia that the '381 patent was not obvious at the time the patent application was filed. HP would not have filed a patent application on the algorithm if it believed the algorithm was obvious. *See* J.A. Ex. C, Agouris Op. Rpt. at p. 35. Thus, HP's filing of a patent application claiming a similar algorithm as in Mr. Moroney's paper further supports the conclusion that the '381 patent was not obvious at the time the patent application was filed. *See* J.A. Ex. C, Agouris Rebuttal Rpt. at p. 35.

E. The Differences Between The Prior Art And Claims 1–3 Would Not Have Been Obvious.

1. The Claims 1–3 and the Gonzalez Algorithm and Gonzalez would not have been obvious.

There is no apparent reason to combine Gonzalez's teaching of image enhancement with the Gonzalez Algorithm. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 36. As explained previously, Gonzalez is a text book that teaches basic image processing techniques. Gonzalez recognized that new techniques were commonplace in the literature. Ex. A, Gonzalez at p. 200. Indeed, Gonzalez knew that its teachings on image enhancement would only serve as a foundation for further study in the field. *Id.* The basic nature of Gonzalez is further shown by the lack of any discussion of power-law transformations like that taught in the '381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 36.

The inappropriateness of the Gonzalez algorithm was discussed at length above with respect to the scope of the prior art. One of ordinary skill in the art would not look to the Gonzalez algorithm for teachings on improving contrast in images so that more details are visible than in the original scene because the Gonzalez algorithm does not achieve this result. *Id.*

Thus, one of ordinary skill in the art, in seeking to improve the contrast in an image on a local basis using a power-law function, would have never looked at the Gonzalez algorithm

[redacted]

because that algorithm can only be used for printing a low-resolution image on a standard line printer. *See* Ex. A, Gonzalez at p. 10. Gonzalez does not suggest that the overstrike capability of a line printer can also be used to enhance pixels of an image. Thus, one of ordinary skill in the art would not have a reasonable expectation of success in improving contrast in images from combining the two references. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 37.

Even if one were to combine the image enhancement techniques of Gonzalez with the Gonzalez algorithm in an attempt to reconstruct the claimed invention, the resulting structure still would be vastly different from the invention of Claims 1–3. *Id.* Because the Gonzalez algorithm is intended for printing low resolution images as test subjects for image enhancement techniques, the resulting structure would be a system for printing a low-resolution image and a histogram process for enhancing pixels in that image. *Id.* The resulting structure would not be a power-law function that utilizes the local average of pixels and the dynamic range of the image in the way claimed in the patent. *Id.*

For all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claims 1–3 would not have been obvious to one of ordinary skill in the art in view of Gonzalez in combination with the Gonzalez algorithm.

2. The differences between Claims 1–3 and the Gonzalez Algorithm and Richard would not have been obvious.

As with Gonzalez, a person of ordinary skill in the art would have no reason to combine teachings from the Gonzalez algorithm with Richard. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 37. Richard teaches a contrast amplifier for video images. The primary purpose of Richard is to teach the use of an amplifier that is not affected by the noise in an image and that can respond favorably to images where noise is found in isolated points or a small number of interrelated points. Ex. B, Richard, col. 1, lines 39–42. Richard does not teach making dark portions of an image brighter and bright portions of an image darker like the invention claimed in the '381

[redacted]

patent. At best, Richard teaches making dark spots darker. *Id.*, col. 6, lines 11–15. If one of ordinary skill in the art started with the teachings of Richard, he or she would have no reason to look to the Gonzalez algorithm to reach the invention claimed in the ’381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 38.

There is no apparent reason for one of skill in the art who was looking for a system for dynamically enhancing contrast in an image to look to a subroutine for printing images on a standard line printer using the printer’s overstrike capability to create the invention of the ’381 patent. *Id.* Richard and the Gonzalez algorithm are directed at two different processing schemes. *Id.* Thus, one of skill in the art would not have a reasonable expectation of success in combining the two. *Id.* And, even if one were to combine the references, the power-law function of Claims 1–3 would not result. *Id.* Instead, the result would be a low-resolution image from a standard line printer that could not be used to even test the video amplifier taught in Richard. *Id.*

Thus, for all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claims 1–3 would not have been obvious to one of ordinary skill in the art in view of Richard in combination with the Gonzalez algorithm.

3. The differences between Claims 1–3 and the Gonzalez Algorithm and Lee would not have been obvious.

A person of ordinary skill in the art would have no apparent reason to combine teachings from the Gonzalez algorithm with Lee. Lee teaches a spatial contrast enhancement algorithm using linear gray level stretching to enhance the pixels in an image. Ex. C, Lee at p. 166. It would not have been obvious to replace the linear function taught by Lee with a function that increased the “stretch in areas of very low light or very high light”. It is a non-trivial step to move from linear transformations, common prior to the ’381 patent, to a non-linear power-law transformation taught in the ’381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 39. Non-linear

[redacted]

transformations are more complicated to design to achieve a certain goal than linear transformations because the outcome is not easily foreseen or predicted. *Id.* In addition, there are a large number of non-linear transformations that have nothing in common but the fact that they are non-linear. *Id.* Linear transformations increases pixel intensities by the same amount regardless of the location of the pixel. *Id.* Even if the contrast measure is based on the average gray level of pixels surrounding the pixel to be enhanced, the modified intensity will still change by the same amount. *Id.* Non-linear transformations, on the other hand, modify pixel intensities by varying amounts across the image. *Id.* The average gray level plays a more significant role in determining the desired output pixel value. *Id.* For that reason, a linear transformation does not easily translate into a non-linear transformation method. *Id.*

One of ordinary skill in the art would not have had a reasonable expectation of success from combining Lee and the Gonzalez algorithm because the Gonzalez algorithm does not teach contrast enhancement. *Id.* In fact, the global method of scaling an image so that it can be printed using the Gonzalez algorithm provides no teachings on how to transform the linear method taught by Lee to the non-linear power-law transformation claimed in the ’381 patent. *Id.*

Thus, for all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claims 1–3 would not have been obvious to one of ordinary skill in the art in view of Lee in combination with the Gonzalez algorithm.

4. The differences between Claim 1 and the Gonzalez Algorithm and Sabri would not have been obvious.

One of ordinary skill in the art would not have a reason to combine the Gonzalez algorithm with Sabri to reach the elements of Claim 1 because neither reference is within the scope of the prior art. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 40. The Gonzalez algorithm is used to print images using the overstrike capability of a line printer. Sabri teaches a system for transmitting color video signals with reduced storage capacity or bandwidth. The two fields are

not related to each other. *Id.* Thus, there is no apparent reason why one of skill in the art would combine teachings from the two to obtain the algorithm taught in Claim 1. *Id.*

Moreover, one of skill in the art would not have had a reasonable expectation of success in combining the two. *Id.* Teachings related to line printers will not combine well with teachings related to video signals because a hard-copy reproduction of an image cannot be used to create and understand how to clean up video signals. *Id.*

Thus, for all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claim 1 would not have been obvious to one of ordinary skill in the art in view of Sabri in combination with the Gonzalez algorithm.

5. The differences between Claims 1–2 and the Gonzalez Algorithm and Rangayyan would not have been obvious.

Rangayyan teaches one of skill in the art to estimate a local contrast measure based on the intensity value of the pixel of interest and the average of its eight neighbors. Ex. E, Rangayyan at. p. 561. Rangayyan then alters the pixel value so that the contrast previously estimated is obtained. *Id.* The goal of the Rangayyan method is to make dark pixels darker and light pixels lighter. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 40. Thus, Rangayyan teaches away from the claimed invention, which does the opposite. One of skill in the art would have no apparent reason to combine the teachings of Rangayyan with those of the Gonzalez algorithm because the Gonzalez algorithm does not teach image enhancement and surely does not teach how to change the enhancement scheme taught in Rangayyan to the power-law function claimed in the ’381 patent. *Id.*

Furthermore, one of skill in the art would not have had a reasonable expectation of success in combining the two references because they are directed at two entirely different problems. *Id.* Rangayyan is directed to making images in medical display devices stand out. The Gonzalez algorithm is directed to printing images on a line printer using the printer’s

overstrike capability. Thus, one of skill in the art with Rangayyan in hand would not look to the Gonzalez algorithm to obtain a power-law function for dynamically enhancing contrast in an image. *Id.*

For all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claims 1 and 2 would not have been obvious to one of ordinary skill in the art in view of Rangayyan in combination with the Gonzalez algorithm.

6. The differences between Claim 1 and the Gonzalez Algorithm and Chen would not have been obvious.

A person of ordinary skill in the art would have no apparent reason to combine Chen with the Gonzalez algorithm. *Id.* at p. 41. As with the other references, Chen and the Gonzalez algorithm are directed to two different fields. *Id.* at p. 42. Thus, one of ordinary skill in the art would not have a reasonable expectation of success in improving contrast in images from combining the two unrelated references.

Moreover, Chen teaches fractal modeling used for improving certain images. Ex. F, Chen, title page. The Gonzalez algorithm teaches how to use a line printer's overstrike capability to print low-resolution images. Ex. H, Gonzalez Algorithm at p. 451. One reference has nothing to do with the other. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 42. One of ordinary skill in the art would not expect to achieve the power law transformation claimed in the '381 patent by combining the teachings of Chen with those of the Gonzalez algorithm.

For all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claim 1 would not have been obvious to one of ordinary skill in the art in view of Chen in combination with the Gonzalez algorithm.

[redacted]

7. The differences between Claims 1–3 and the Gonzalez Algorithm and Narendra would not have been obvious.

Narendra teaches the use of a recursive filter to accomplish real-time adaptive contrast enhancement. Ex. G, Narendra, Abstract. This is contrary to the non-recursive algorithm taught in the ’381 patent. J.A. Ex. C, Agouris Rebuttal Rpt. at p. 42. One of skill in the art would not have an apparent reason to combine the Gonzalez algorithm, which does not teach contrast enhancement, with the teachings of Narendra to obtain the non-recursive, power law function taught in Claims 1–3 of the ’381 patent. *Id.* One of ordinary skill in the art would not have a reasonable expectation of success in improving contrast in images from combining the two references. *Id.*

Thus, for all of the reasons discussed above, and taking into account the objective indicia and the level of ordinary skill in the art, Claims 1–3 would not have been obvious to one of ordinary skill in the art in view of Narendra in combination with the Gonzalez algorithm.

<u>CONCLUSION</u>

In view of the scope and content of the prior art, the differences between the asserted claims and the art relied upon by HP, the objective indicia of non-obviousness with respect to Claims 1–3, and the level of ordinary skill in the art, Claims 1–3 would not have been obvious to one of ordinary skill in the art at the time of the invention. Polaroid therefore requests entry of summary judgment that Claims 1-3 are not invalid for obviousness.

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MORRIS, NICHOLS, ARSHT & TUNNELL LLP

/s/ Julia Heaney

Jack B. Blumenfeld (#1014)
Julia Heaney (#3052)
1201 N. Market Street
Wilmington, Delaware 19801
jblumenfeld@mnat.com
jheaney@mnat.com
(302) 658-9200

Attorneys for Plaintiff Polaroid Corporation

OF COUNSEL:

Russell E. Levine, P.C.
G. Courtney Holohan
Michelle W. Skinner
David W. Higer
Maria A. Meginnes
KIRKLAND & ELLIS LLP
200 East Randolph Drive
Chicago, IL 60601
(312) 861-2000

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CERTIFICATE OF SERVICE

I, the undersigned, hereby certify that on May 23, 2008, I electronically filed the foregoing with the Clerk of the Court using CM/ECF, which will send notification of such filing(s) to the following:

William J. Marsden, Jr.
FISH & RICHARDSON P.C.

I also certify that copies were caused to be served on May 23, 2008 upon the following in the manner indicated:

BY E-MAIL

William J. Marsden, Jr.
FISH & RICHARDSON P.C.
919 N. Market Street, Suite 1100
Wilmington, DE 19801

Matthew Bernstein
John E. Giust
MINTZ LEVIN COHN FERRIS GLOVSKY AND POPEO PC
5355 Mira Sorrento Place
Suite 600
San Diego, CA 92121-3039

Bradley Coburn
FISH & RICHARDSON P.C.
One Congress Plaza, Suite 810
111 Congress Avenue
Austin, TX 78701

Daniel Winston
CHOATE HALL & STEWART, LLP
Two International Place
Boston, MA 02110

/s/ Julia Heaney (#3052)

Julia Heaney (#3052)